California Department of Water Resources
Oroville Facilities
Preliminary Issue Sheet

F1. Effects of Existing and Future Project Operations on Fish and Aquatic Resources

Issue Statement: Effects of existing and future project operations (including power generation, water storage, ramping rates, and releases, pump-back, water levels, and water level fluctuations) during all water year types on the behavior (e.g., migration timing, microhabitat selection, vulnerability to predators), reproduction, survival and habitat of warm- and cold-water fish and other aquatic resources (e.g., macro invertebrates), which include project waters and tributaries within the project boundaries (Lake Oroville, Diversion Pool, Fish Barrier Pool, Forebay, Afterbay, Oroville Wildlife Area), and in project affected waters.

Resource Goals:

- Minimize and mitigate adverse project related effects on fish and aquatic resources.
- Cold- and warm-water fisheries sufficient to support desired recreational and commercial fisheries.
- Healthy native fish assemblage.

Scope: Within the FERC project boundary waters, and the tributaries upstream to the current upper fish migratory limit, and the Feather River downstream from the Fish Barrier Dam to the Yuba River. The Study scope could extend downstream to the mouth of the Feather River for some elements of this issue. The specific downstream scope will be defined for each element in the Study Plan.

Existing Information:

<u>FERC Project Waters and Tributaries to Upper Migratory Limit</u>

1. DWR Lake Oroville Annual Reports of Fish Stocking and Fish Habitat Enhancements to FERC, 1994-1999 - Lake Oroville fishery management information:
    a. Resident fish stocking data
    b. Resident fish species data
    c. Fish habitat enhancement projects
2. DWR Lake Oroville 90-Day Fishery Reports to FERC, 1995-1999 - Lake Oroville fishery management information:
    a. Resident fish species data
    b. Resident fish stocking data
    c. Fish habitat enhancement projects
    d. Temperature profiles
3. DWR Lake Oroville Fisheries Habitat Enhancement Plan, 1995 - Lake Oroville fish habitat and habitat enhancement information.
4. DWR Lake Oroville Fishery Management Plan Progress Report, October 1993 - Lake Oroville fishery information, tributary information.
5. DWR Amended Recreation Plan for Lake Oroville State Recreation Area, 1993 - Lake Oroville fishery information.

6. DWR project operations data, including surface elevations of project reservoirs and inflow/outflow data.
7. PG&E FERC relicensing proceedings and studies of North Fork Feather River projects - Including draft Poe Project License Application. Information on tributary (North Fork Feather River) fish.
8. Various DFG studies, management plans and activities, such as:
    a. An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River, 1977
    b. DFG Inland Fisheries Division - Information Leaflet No. 42, Warm Water Reservoir Fish Habitat Improvement Guide
    c. DFG annual reports on fish habitat enhancement
    d. Strategic Plan For Trout Management
9. Geomorphic information listed in G1 such as:
    a. 1993-1994 DWR Lake Oroville Siltation Study
10. DWR letters to FERC (4/16/01 & 7/13/00) - updates to FERC regarding IHN and its impact on Lake Oroville fishery management.
11. California Department of Fish and Game (DFG) sponsored IHN resistance study at University of California, Davis - preliminary reports:
    a. Various salmon and trout strains investigated, including coho and kokanee salmon, lake trout, brook trout, brown trout, rainbow trout-Pit River strain, coastal and Lahontan cutthroat trout
12. DFG Fish Health Lab reports on IHN at Feather River Hatchery - prepared periodically during the year, particularly during the fall spawning season.
13. Miscellaneous DFG Fish Health Lab reports - various fish diseases (both warm and cold water) that occur periodically in project waters, as well as other similar California waters.
14. Miscellaneous publications on fish diseases - from State and federal fish and wildlife agencies, and other appropriate sources, such as:
    a. DFG Fish Bulletins
    b. U.S. Fish and Wildlife Service publications
    c. State of Washington, Department of Fisheries, Hatchery Division
    d. Utah Division of Wildlife Resources
15. Current DFG/NMFS assessment of hatchery impacts.
16. DWR/DFG water temperatures criteria for the Feather River Hatchery.
17. Feather River Hatchery Production Goals and Constraints, Operational Plans
18. Other historic literature related to fish habitat within the FERC project waters

<u>Feather River Below FERC Project Waters</u>

1. Abundance and emigration timing of juvenile salmon and steelhead since 1996. Data comes from DWR-ESO operation of rotary screw traps, fyke traps, and seining. Traps typically operated from December through June.
2. Annual population estimates for fall and spring run salmon returning to spawn. Surveys conducted by DFG (using various methods) every fall since 1954.
3. Distribution and habitat use of juvenile salmon and steelhead. DWR-ESO study began in spring of 1999, utilizes snorkeling observations. Surveys are conducted from March - August on the Feather River between the Fish Barrier Dam and Gridley Bridge.
4. Survival and contribution rate of “wild” and hatchery produced salmon:
    a. DWR-ESO and DFG have been implanting coded wire tags in juvenile hatchery salmon since 1975. DWR-ESO began tagging “wild” juvenile salmon in 1998

b. Tags are recovered through ocean and inland harvest recovery programs coordinated by DFG
c. New analysis of tag recoveries underway through contract with SFSU Romberg Tiburon Center and USFWS

5. Habitat surveys, habitat maps and gravel surveys:
   a. Depth, current velocity, substrate, in-stream cover, over-head cover are recorded as part of DWR-ESO steelhead and salmon habitat use studies in 1999 and 2000
   b. Riffles, pools, glides and backwater habitats have been delineated on aerial photographs from the Fish Barrier Dam to the Gridley Bridge. This mapping was conducted by DWR-ESO as part of lower river fish studies in 1999, and with 1992 IFIM studies
   c. DWR Northern District published Feather River gravel condition reports in 1982 and 1996
6. Historic stream flows in the low flow channel and below Thermalito Afterbay outlet.
7. Temperature data from the low flow channel and below Thermalito Afterbay outlet:
   a. Hourly temperatures recorded at 20 sites between the Thermalito Diversion Dam and Live Oak by DWR-ESO. Began in 1997 but records are incomplete until 1999
   b. USGS recorded temperatures at gage downstream from Oroville Dam, 1958 to 1992, continuous temperatures since 1995 ???
   c. OFD has recorded mean daily water temperatures at the Feather River Hatchery since initiation of hatchery operations and Robinson Riffle since July 31, 2000
   d. USGS has published records of maximum and minimum daily water temperatures at the Thermalito Afterbay Outlet from October 1968 through September of 1992. Since 1992, only mean daily water temperature data is available from OFD
   e. River temperature model developed by UC Davis under contract with DWR-ESO in 2000
8. DWR-ESO Instream Flow study from 1992. Thirty-two transects selected between the Fish Barrier Dam and Honcut Creek. Salmon, steelhead and American shad were the target species.
9. Laboratory study on steelhead growth and thermal biology. Study conducted by UC Davis in 1999 under contract with DWR-ESO.
10. Macro-invertebrate food base available for rearing salmon and steelhead. Study began in Fall 2000 and will continue for two years. Funded by DWR-ESO through contract with Chico State University.
11. Stranding and redd dewatering study by DWR-ESO began in Fall 2000. Study will identify potential stranding areas between the Fish Barrier Dam and Honcut Creek, and attempt to quantify salmonid losses.
12. Various DFG studies, management plans and activities, such as:
    a. An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River, 1977
13. 2000 Spring-run and steelhead Biological Assessment.
14. National Marine Fisheries Service temperature criteria for the Feather River at Robinson Riffle (low flow channel) in the 2001 biological opinion.
15. Geomorphic information listed in G1 such as:
    a. 1982 DWR Feather River Spawning Gravel Baseline Study
    b. 1967 USGS report, "Sediment Transport in the Feather River, Lake Oroville to Yuba City, California

16. NMFS Habitat Conservation Plan with CDFG on striped bass stocking program.
17. Other historic literature related to fish habitat within the FERC project waters and the Feather River downstream to Yuba River.

Information Needed:

Due to the considerable overlap of this Issue Sheet with several other Fishery Issue Sheets, the information needs listed below will be derived from the studies and analyses conducted in the other Issue Sheets cited

FERC Project Waters and Tributaries to Upper Migratory Limit

1. Development of conceptual model of reservoir fisheries and aquatic resources and project impacts (F2-F7, F9, F13):
    a. Identification of reservoir fisheries and aquatic resources
    b. Life history characteristics of fishery and aquatic resources
    c. Assessment of impacts and interaction of project operations on fisheries and aquatic resources
2. Identification of upper migratory limit through field assessment and literature review (F2, F4, F5, F7)
3. Identification of fish habitat types using field sampling and literature review (F3-F5, F7, F15)
4. Reservoir surface fluctuation model results in different water year types, and identification of affect on fish and aquatic resources (F3, F5, F7).

5. Temperature modeling results of project waters, and project affected waters (F3, F5, F7, W3, W13).
6. Flow of Feather River tributaries in different water year types (F7, W3).
7. DFG sponsored IHN evaluation listed in F2.
    a. U.C. Davis IHN resistance studies
    b. Evaluation of IHN presence in FERC project waters, Feather River, and selected tributaries
8. Literature review of other (non-IHN) fish diseases listed in F2, including an identification of the mechanism of disease transmission, and, if possible, a determination of whether the project (and its associated fishery management plans) affected the establishment, extent, and control of these disease outbreaks.
9. Literature review and analyses listed in G1 related to resident fish habitat.
10. Baseline data for fish and invertebrates in tributaries below the Dam to the Diversion Pool and at Forebay (impacts of trail maintenance, potential bridge sites, etc. as part of habitat assessment for fisheries)

Feather River Below Oroville Dam

1. Accurate data on arrival timing, spawning season, and population size of adult spring-run salmon. This information could be gathered by operating an upstream migrant counting facility, using a weir and/or hydroacoustics. Supplemental information could also be gathered by extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River (F10, F13).
2. Data on arrival timing and population size of “wild” adult steelhead. This information could be gathered by operating an upstream migrant counting facility, using a weir and/or hydroacoustics. Supplemental information could also be gathered by

extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River (F10, F13).

3. Residence time, survival and growth of adult and juvenile steelhead in the low flow channel. This information could be gathered by tagging steelhead and tracking their movement, survival and growth while living in the Feather River F10, F13)
4. Literature review on basic life history and potential project impacts on non-salmonid anadromous fishes including striped bass, American shad, green sturgeon, and white sturgeon (F10).
5. Continuation and/or modification of studies listed in existing information (Feather River below Oroville Dam) specifically item numbers 1, 3, 4, 7a, 10.
6. Materials identified in Issue Sheet G1 (Items 1 through 4) and W3 (Items 1c and 3).
7. Preliminary instream flow study designed to evaluate channel changes since 1992 IFIM study and to specifically address flow effects on juvenile steelhead.
8. Estimate of the change in amount of spawning and rearing habitat for salmonids due to project operations (F6, F10, F13).
9. Results from Index of Hydrologic Alteration (IHA) analysis (G5)
10. Anticipated future flow conditions (modeling results – see G5)
11. Assessment of sediment deposition and erosion on reservoir and riverine aquatic habitats (F6).
12. Proposed recreation development from relicensing effort (F6).
13. Genetic study of Feather River steelhead to determine relatedness to other Central Valley stocks, and to test for hybridization (is hybridization the correct term to be using?) of hatchery and wild steelhead (F9).
14. Water quality effects of discharge (e.g., nutrients, chemical treatments) from Feather River Hatchery on wild salmonids in the Feather River. (Water Quality Issue Sheet 11 info, F9)
15. Water quality impacts (e.g. low dissolved oxygen, nutrient loading) of large spawning runs of hatchery salmon on stream health and wild fish production (F9).
16. Desktop study on the effects of crowding and redd superimposition associated with large runs of hatchery salmon on the success of in-river spawning salmonids, particularly spring-run salmon and steelhead (F9).
17. Continuation and/or modification of studies listed in existing information, specifically item numbers 1, 3, 4, 6a, and 9.
18. Synthesis of existing and new information to evaluate project impacts on anadromous fish, resident fish, and aquatic resources (F10).

Level of Analysis:

Literature review and site specific field assessment of fishery and aquatic resources and fish habitat, and desktop study of project effects on fishery and aquatic resources.

Issues Addressed by Issue Statement:

FE1 Are the project related Lake Oroville water level fluctuations presently affecting the reproduction and survival of warm-water sportfish;

FE2 How will the project related Lake Oroville water level fluctuations affect the reproduction and survival of warm-water sportfish under future operational demands;

FE3 Is the present minimum pool adequate for protecting the Lake Orville cold-water sport fishery;

FE8 Lake Oroville releases made for power generation may cause dramatic fluctuations in lake level. What are the potential impacts of fluctuation zone and surface elevation change on recreation opportunities and on fish and wildlife habitat?

FE23 Hire a full-time independent biologist for Lake Oroville in addition to DWR biologist;

FE52 Facility operations and impact – on bass fishery and spawning activities at afterbay (protect and enhance bass fishery);

FE59 Protect and improve habitat for trout;

FE66 Expand land-lock fishery to include all salmon not just Chinook;

FE68 Assurances of how things will be done, guarantee credible data, and sustainability of solutions (adaptive management);

FE78 Quality and extent of habitat above currently impassable barriers to migration;

FE83 Macroinvertebrates as an indicator of water quality;

FE84 Evaluate indicators of hydrological alteration (IHA analysis);

FE85 Impact of project facilities and operations on fish passage includes structures, flows, and/or water quality conditions that impede or block passage within and from current and/or historic habitat and operations that impact passage or have the potential to enhance passage. Passage includes movement of spawning or holding adults, emigrating smolts, or movement of juveniles to different habitat areas for purposes of feeding, avoiding predators, or sheltering;

FE86 Adequacy of current ramping rate to protect anadromous salmonids and conserve their habitats and forage. This includes providing a range of schedule of flows necessary to optimize habitat, stable flows during spawning and incubation of in gravel forms, flows necessary to ensure redd replacement in viable areas, and flows necessary for channel forming processes, riparian habitat protection and maintenance of forage communities. This also includes impacts of flood control or other project structures or operations that act to displace individuals or their forage or destabilizes, scours, or degrades habitat;

FE89 Impact of project structures and operations on water quality conditions necessary to sustain anadromous salmonids and their habitats;

FE90 Adequacy of current project operating regimes and structures to optimize water quality conditions for anadromous salmonids and their habitats;

FE91 Current condition of habitat potentially impacted by project and alternatives to conserve or enhance anadromous salmonids;

FE93 Introgression occurring between fall-run and spring-run Chinook populations in the Feather River due to hatchery practices and impassable migration barriers;

FE95 The lower Feather River provides habitat to support a variety of anadromous fish species including Chinook salmon, steelhead, striped bass, American shad and sturgeon. Potential changes in license conditions could adversely impact habitat supporting these species. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements for the various life history needs of anadromous species including flow, water temperature, instream and riparian cover, substrate and spatial area;

FE96 The lower Feather River provides habitat to support a variety of resident native and resident introduced species including coldwater species such as rainbow, brook, and brown trout, and warm water species such as bass, catfish, bluegill, green sunfish, carp and others. Potential changes in license conditions could adversely impact habitat supporting these species or upset habitat conditions such that less desirable species are favored. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative

improvements for the various life history needs of these resident native and non-native species including flow, water temperature, instream and riparian cover, substrate and spatial area;

FE97 The habitat for fishes in the lower Feather River is affected by the flow releases from the project. Seasonal timing, volume, and rate of release all have an affect on fish habitat conditions. Potential changes in license conditions for flow releases could adversely affect habitat conditions for one or more fish species. Fishery investigations should examine the adequacy of flows for maintaining all life history needs for anadromous and resident species. There should be evaluation of potential for flow improvements in the low-flow section. Fishery investigations should be sufficient to determine how best to meet the combined needs of the various anadromous and resident fish species;

GE7 Are the present streamflows defined under the SWP Feather River Flow Constraints adequate for maintaining natural fluvial river functions in the low-flow section and in the river downstream of Thermalito Afterbay (i.e., diversity of habitats: pool to riffle ratios, pool depth, stream bank angle, stream bank stability, stream bank vegetative cover, bedload deposition pattern, and stream bank vegetation root depth versus stream bank height above bankfull height);

GE20 Indicators of hydrological alteration (IHA analysis);

GE23 Releases that reflect nature cycles benefit biological cycles – how have changes in seasonal release patterns affected fish, invertebrates, and their habitat;

GE25 Natural geomorphological processes historically occurred within the Feather River watershed and are the result of geologic and hydrologic processes such as weathering, erosion, runoff patterns, material transport and deposition. Project features and operations have altered these natural geomorphic processes. Alteration of these geomorphic processes has affected the riverine habitat and species that depend on it. The FWS is concerned that project operations may have taken us beyond some critical thresholds for ecosystem sustainability. We are concerned that maintenance of a satisfactory abiotic template (e.g., substrate used for invertebrate production and fish spawning) is not occurring). The FWS wants assurance that new license conditions will allow for minimum thresholds of geomorphic processes to take place thus ensuring sufficient natural sediment movement and a satisfactory abiotic habitat template are in place;

G1 Effects of existing and future project operations on natural geomorphic processes. These include physical attributes and functions (e.g., channel morphology, channel stability, sediment transport and deposition, spawning gravel and large woody debris recruitment, habitat diversity) and subsequent effects on biological resources (e.g., aquatic macro-invertebrates, riparian vegetation) in the low-flow section and in the Feather River downstream of Thermalito Afterbay under wet and dry year criteria. Also, see W8,F3,F10, T5;

T1 Effects of project features, operations (including power generation, water releases, pump-back, water levels and water level fluctuations) and maintenance on wildlife and wildlife habitat. Specific concerns include deer winter range, bandtailed pigeon winter habitat, designated emphasis and harvest species, wintering and nesting waterfowl, and other wildlife use of project and project-affected waters;

TE39 Manage flows and/or reservoir storage to maintain or enhance riparian plant communities and habitat for all life stages of fish. Cooperate with local, State,

and other Federal water management agencies. Protect riparian areas while providing developed facilities;

W1 Effects of existing and future project operations and facilities on all designated beneficial uses of the water. The beneficial uses for the Feather River watershed as defined in the Basin Plan include municipal and domestic supply, agriculture, electrical power production, contact recreation, warm-water and cold-water fish spawning, rearing and migration, freshwater habitat, and wildlife habitat;

W2 Effects of existing and future project operations on compliance with water quality objectives identified in the Regional Water Quality Control Board (RWQCB) Basin Plan. Specific compliance issues include bacteria, chemical constituents, dissolved oxygen, pH, oil and grease, pesticides, sediment, temperature, toxicity, and turbidity;

W3 Effects of existing and future project operations on the physical, chemical and biological components of water quality of the Feather River, affected tributaries and downstream waters. The project has the potential for direct and indirect effects on aquatic ecosystem health, on recreational opportunity, and on domestic and agricultural water supply;

W9 Effects of existing and future project facilities and operations on thermal stratification and other thermal processes on project waters, including availability of cold water for release in various water year types under current and future operational demands;

W10 Effects of existing and future water releases and operations on water temperatures in the Diversion Pool, Forebay, Afterbay, Oroville Wildlife Area, low-flow section of the river and downstream areas; at the hatchery; for agriculture; and the quality and availability of habitat for salmonids and other aquatic resources;

W12 Effects of existing and future project facilities and operations on access to the cold-water pool during below normal (BN) water years and multiple BN water years under existing and future operational demands, and effectiveness of the Temperature Control Device in providing access;

W13 Effects of existing and future hatchery operations on water quality and water temperatures in the Feather River and Afterbay;

W14 Effects of existing and future pump-back operations on water quality and water temperatures (in Lake Oroville, Diversion Pool, Forebay, Afterbay, and Oroville Wildlife Area), habitat suitability, and outmigration for salmonids;

WE19 Is the availability of a cold-water pool in Lake Oroville adequate under present and future operational demands to meet the existing downstream cold fresh-water habitat requirements of steelhead and fall, late-fall, and spring-run chinook salmon;

WE30 Are dissolved oxygen levels in the Feather River from Thermalito Afterbay to Live Oak a problem during the spring, summer, and fall months;

WE32 Thermalito Afterbay acts as a thermal retention basin for project water prior to delivery to water districts outside the project boundary. How do releases from this water body affect the stream temperature and dissolved oxygen content of Feather River receiving waters;

WE36 Both cold-water and warm-water habitat, spawning, and migration uses have been designated for surface waters potentially affected by the project. A determination must be made as to the specific thermal habitat that may be reasonably provided in each water body within project boundaries and downstream of the project.

California Department of Water Resources
Oroville Facilities
Preliminary Issue Sheet

F5. Effects of Fisheries Management Plans on a Balanced Fishery

Issue Statement: Effects of existing and proposed fisheries management plan(s) and activities on a balanced cold- and warm-water fishery (including stocking levels, hatchery management and production relative to in-river populations, habitat enhancement projects, predator and undesirable species control, and prevention of future introductions (e.g., Northern pike, striped bass, etc.), disease, tree stakes and tire removal, and harvest).

Resource Goals:

- Minimize and mitigate adverse project related effects on a balanced warm and cold water fishery.
- Provide a balanced warm and cold water fishery.

Scope: Within the FERC project boundary waters and the tributaries upstream to the current upper migratory limit, and the Feather River downstream to the Yuba River. The Study scope could extend downstream to the mouth of the Feather River for some elements of this issue. The specific downstream scope will be defined for each element in the Study Plan.

Existing Information:

<u>FERC Project Waters and Tributaries to Upper Migratory Limit</u>

1. DWR Lake Oroville Annual Reports of Fish Stocking and Fish Habitat Enhancements to FERC, 1994-1999 - Lake Oroville fishery management information:
    a. Resident fish stocking data
    b. Resident fish species data
    c. Fish habitat enhancement projects
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    a. Resident fish species data
    b. Resident fish stocking data
    c. Fish habitat enhancement projects
    d. Temperature profiles
3. DWR Lake Oroville Fisheries Habitat Enhancement Plan, 1995 - Lake Oroville fish habitat and habitat enhancement information.
4. DWR Lake Oroville Fishery Management Plan Progress Report, October 1993 - Lake Oroville fishery information, tributary information.
5. DWR Amended Recreation Plan for Lake Oroville State Recreation Area, 1993 - Lake Oroville fishery information.
6. DWR project operations data, including surface elevations of project reservoirs and inflow/outflow data.
7. PG&E FERC relicensing proceedings and studies of North Fork Feather River projects - Including draft Poe Project License Application. Information on tributary (North Fork Feather River) fish.
8. Various DFG studies, management plans and activities, such as:

a. An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River, 1977
b. DFG Inland Fisheries Division - Information Leaflet No. 42, Warm Water Reservoir Fish Habitat Improvement Guide
c. DFG annual reports on fish habitat enhancement
d. Strategic Plan For Trout Management

9. Geomorphic information listed in G1 such as:
    a. 1993-1994 DWR Lake Oroville Siltation Study
10. DWR letters to FERC (4/16/01 & 7/13/00) - updates to FERC regarding IHN and its impact on Lake Oroville fishery management.
11. California Department of Fish and Game (DFG) sponsored IHN resistance study at University of California, Davis - preliminary reports:
    a. Various salmon and trout strains investigated, including coho and kokanee salmon, lake trout, brook trout, brown trout, rainbow trout-Pit River strain, coastal and Lahontan cutthroat trout
12. DFG Fish Health Lab reports on IHN at Feather River Hatchery - prepared periodically during the year, particularly during the fall spawning season.
13. Miscellaneous DFG Fish Health Lab reports - various fish diseases (both warm and cold water) that occur periodically in project waters, as well as other similar California waters.
14. Miscellaneous publications on fish diseases - from State and federal fish and wildlife agencies, and other appropriate sources, such as:
    a. DFG Fish Bulletins
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    c. State of Washington, Department of Fisheries, Hatchery Division
    d. Utah Division of Wildlife Resources
15. Current DFG/NMFS assessment of hatchery impacts.
16. DWR/DFG water temperatures criteria for the Feather River Hatchery.
17. Feather River Hatchery Production Goals and Constraints, Operational Plans
18. Other historic literature related to fishery management plans within the FERC project waters.

<u>Feather River Below FERC Project Waters</u>

1. Abundance and emigration timing of juvenile salmon and steelhead since 1996. Data comes from DWR-ESO operation of rotary screw traps, fyke traps, and seining. Traps typically operated from December through June.
2. Annual population estimates for fall and spring run salmon returning to spawn. Surveys conducted by DFG (using various methods) every fall since 1954.
3. Distribution and habitat use of juvenile salmon and steelhead. DWR-ESO study began in spring of 1999, utilizes snorkeling observations. Surveys are conducted from March - August on the Feather River between the Fish Barrier Dam and Gridley Bridge.
4. Survival and contribution rate of “wild” and hatchery produced salmon (include evaluation of likely future hatchery operations or changes in operations i.e. trucking):
    a. DWR-ESO and DFG have been implanting coded wire tags in juvenile hatchery salmon since 1975. DWR-ESO began tagging “wild” juvenile salmon in 1998
    b. Tags are recovered through ocean and inland harvest recovery programs coordinated by DFG

c. New analysis of tag recoveries underway through contract with SFSU Romberg Tiburon Center and USFWS

5. Habitat surveys, habitat maps and gravel surveys:
    a. Depth, current velocity, substrate, in-stream cover, over-head cover are recorded as part of DWR-ESO steelhead and salmon habitat use studies in 1999 and 2000
    b. Riffles, pools, glides and backwater habitats have been delineated on aerial photographs from the Fish Barrier Dam to the Gridley Bridge. This mapping was conducted by DWR-ESO as part of lower river fish studies in 1999, and with 1992 IFIM studies
    c. DWR Northern District published Feather River gravel condition reports in 1982 and 1996
6. Historic stream flows in the low flow channel and below Thermalito Afterbay outlet.
7. Temperature data from the low flow channel and below Thermalito Afterbay outlet:
    a. Hourly temperatures recorded at 20 sites between the Thermalito Diversion Dam and Live Oak by DWR-ESO. Began in 1997 but records are incomplete until 1999
    b. USGS recorded temperatures at gage downstream from Oroville Dam, 1958 to 1992, continuous temperatures since 1995
    c. OFD has recorded mean daily water temperatures at the Feather River Hatchery since initiation of hatchery operations and Robinson Riffle since July 31, 2000
    d. USGS has published records of maximum and minimum daily water temperatures at the Thermalito Afterbay Outlet from October 1968 through September of 1992. Since 1992, only mean daily water temperature data is available from OFD
    e. River temperature model developed by UC Davis under contract with DWR-ESO in 2000
8. DWR-ESO Instream Flow study from 1992. Thirty-two transects selected between the Fish Barrier Dam and Honcut Creek. Salmon, steelhead and American shad were the target species.
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10. Macro-invertebrate food base available for rearing salmon and steelhead. Study began in Fall 2000 and will continue for two years. Funded by DWR-ESO through contract with Chico State University.
11. Stranding and redd dewatering study by DWR-ESO began in Fall 2000. Study will identify potential stranding areas between the Fish Barrier Dam and Honcut Creek, and attempt to quantify salmonid losses.
12. Various DFG studies, management plans and activities, such as:
    a. An Evaluation of Fish Populations and Fisheries in the Post-Oroville Project Feather River, 1977
13. 2000 Spring-run and steelhead Biological Assessment.
14. National Marine Fisheries Service temperature criteria for the Feather River at Robinson Riffle (low flow channel) in the 2001 biological opinion.
15. Geomorphic information listed in G1 such as:
    a. 1982 DWR Feather River Spawning Gravel Baseline Study
    b. 1967 USGS report, "Sediment Transport in the Feather River, Lake Oroville to Yuba City, California
16. NMFS Habitat Conservation Plan with CDFG on striped bass stocking program.

17. Survival and contribution rate of “wild” and hatchery produced salmon.
    a. DWR-ESO and DFG have been implanting coded wire tags in juvenile hatchery salmon since 1975. DWR-ESO began tagging “wild” juvenile salmon in 1998.
    b. Tags are recovered through ocean and inland harvest recovery programs coordinated by DFG.
    c. New analysis of tag recoveries underway through contract with SFSU Romberg Tiburon Center and USFWS.
18. Other historic literature related to fishery management plans in the Feather River downstream to Yuba River.

Information Needed:

<u>FERC Project Waters and Tributaries to Upper Migratory Limit</u>

1. Development of conceptual model of fishery management plans within the FERC project waters and tributaries to the upper migratory limit and impacts and interaction with protected species and recreational fisheries (most of this information would be derived from studies carried out in Issue Sheets F1-F4, F7):
    a. Identification of fishery management plans (i.e. hatchery management plans, protected species regulations, water temperature management, fish stocking plans, habitat enhancement plans, etc.)
    b. Assessment of impacts and interaction of these plans with protected species and recreational fisheries, and development of recommendations on how to minimize adverse affects on a balanced warm and coldwater fishery
2. Identification of upper migratory limit through field assessment and literature review - derived from studies carried out in F1, F7)
3. Reservoir surface fluctuation model results in different water year types, and affect on habitat availability and condition (also listed in F1, F7).
4. Temperature modeling results of project waters, and project affected waters (also listed in W3, W13).
5. DFG sponsored IHN evaluation listed in F2.
    a. U.C. Davis IHN resistance studies
    b. Evaluation of IHN presence in FERC project waters, Feather River, and selected tributaries
6. Literature review of other (non-IHN) fish diseases listed in F2, including an identification of the mechanism of disease transmission, and, if possible, a determination of whether the project (and its associated fishery management plans) affected the establishment, extent, and control of these disease outbreaks.

<u>Feather River Below Oroville Dam</u>

1. Development of conceptual model of fishery management plans in the Feather River below Oroville Dam and impacts and interaction with protected species and recreational fisheries (most of this information would be derived from studies carried out in Issue Sheets F1-F3, F7, F9-F16):
    a. Identification of fishery management plans (i.e. hatchery management plans, protected species regulations, water temperature management, fish stocking plans, habitat enhancement plans, etc.)
    b. Assessment of impacts and interaction of these plans with protected species and recreational fisheries, and development of recommendations on how to minimize adverse affects on a balanced warm and coldwater fishery

2. Evaluation of stocked resident and introduced species on wild anadromous salmonids.

Level of Analysis:

Literature review and site specific field assessment of fishery resources and management plans; desktop study of fisheries management plans and how they may affect a balanced fishery.

Issues Addressed By Issue Statement:

FE15 Develop and maintain a balanced fishery;
FE18 Develop and implement a long-term fisheries management plan;
FE19 Rearing bass (plants) for recreational and trophy fishery;
FE22 Prevent Northern Pike from entering Lake Oroville by eliminating them from the licensee's upstream impoundments. If Northern Pike enter Lake Oroville and Feather River watershed, aggressively address the problem and successfully eliminate the fish;
FE23 Hire a full-time independent biologist for Lake Oroville in addition to DWR biologist;
FE44 Increase emphasis on steelhead protection and habitat and less on salmon;
FE47 Desire to see a balanced fishery;
FE52 Facility operations and impact – on bass fishery and spawning activities at afterbay (protect and enhance bass fishery);
FE58 Improve and protect habitat for designated emphasis and harvest species. Identify and evaluate potential conflicts among project effects and management actions for protected and sensitive species;
FE63 Coordination between re-licensing effort and existing management plans in and out of the project boundary
FE65 Explore offsite mitigation opportunities
FE70 Potential to reopen salmon fishery above Highway 70 bridge
FE73 Responsible management by resource agencies;
FE79 Oroville Reservoir provides substantial recreational fishing opportunity for both black bass and Chinook salmon fisheries. Hatchery planting practices for Chinook salmon could be impacting habitat conditions and the population dynamics of black bass and other species, thus impairing socioeconomic use. Fishing interests want to improve the reservoir fishery so that it becomes a more popular recreational destination as a result of a successful balanced species reservoir fishery. An appropriate balance of species should exist in the reservoir to support environmental sustainability and long-term maintenance of a healthy ecosystem;
FE91 Current condition of habitat potentially impacted by project and alternatives to conserve or enhance anadromous salmonids;
FE92 Priority of salmonid habitat conservation in current operating criteria and various operating agreements;
FE95 The lower Feather River provides habitat to support a variety of anadromous fish species including Chinook salmon, steelhead, striped bass, American shad and sturgeon. Potential changes in license conditions could adversely impact habitat supporting these species. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements

for the various life history needs of anadromous species including flow, water temperature, instream and riparian cover, substrate and spatial area;

FE96 The lower Feather River provides habitat to support a variety of resident native and resident introduced species including coldwater species such as rainbow, brook, and brown trout, and warm water species such as bass, catfish, bluegill, green sunfish, carp and others. Potential changes in license conditions could adversely impact habitat supporting these species or upset habitat conditions such that less desirable species are favored. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements for the various life history needs of these resident native and non-native species including flow, water temperature, instream and riparian cover, substrate and spatial area;

FE100 Create more habitat for the black bass and warm water fishes such as spawning beds or boxes; spawning plates or stationary buoy cables.

G3 The need to coordinate long-range watershed planning activities with local, state and federal agencies and private landowners. See WE15

T6 Interagency management coordination; adequacy of management plans and activities and funding for wildlife management

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F8. Anadromous Fish Nutrient Transport

Issue Statement: Project effects on resource energy balance in terms of changes in biomass and nutrient dispersal due to loss of anadromous fish carcasses upstream of Lake Oroville (on fish and wildlife).

Resource Goals:

- Minimize and mitigate project related impacts on nutrient transport to tributaries of project waters.

Scope: Within the FERC project boundary waters and the tributaries upstream to the pre-project upper migratory limit for fish.

Existing Information:

1. Annual population estimates for fall and spring run salmon returning to spawn. Surveys conducted by DFG (using various methods) every fall since 1954.

Information Needed:

1. Literature review and preliminary analysis of impacts to fish and wildlife species in project tributaries caused by loss of salmon carcasses delivery to upstream areas. Review will include findings from W3 upstream nutrient studies. Impacts to resident fish management and potential disease problems would be among the topics considered.
2. Literature review to determine extent of pre-project upstream migration limits for anadromous fish.

Level of Analysis:

Literature review evaluating loss of salmon carcasses to upstream areas and how this may impact energy balance and upstream fish and wildlife resources.

Issues Addressed by Issue Statement:

FE29. Protection of upstream resources energy balance issues – historic uses salmon – steelhead moving upstream – biomass – nutrient dispersal.

FE82. Prior to construction of Oroville Dam anadromous fish had access to the POE reach of the North Fork Feather River. These fish provided a source of energy to the river ecosystem. Construction of the dam severed that connection. There is an interest in determining the contribution of anadromous fish as an energy source for aquatic dependent species located in the North Fork Feather River and devising a strategy for replacing this loss.

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F11. Compliance and Adequacy of Flow Constraints

Issue Statement: Compliance of project operations with SWP Feather River Flow Constraints and adequacy of constraints to protect anadromous fish and other aquatic species in the low-flow section and in the river downstream of the Afterbay.

Resource Goals:

- Minimize and mitigate adverse project impacts on habitat, genetic integrity and population size of anadromous fishes.
- Provide populations of anadromous fish sufficient to support desired recreational and commercial fisheries.

Scope: Feather River from the Fish Barrier Dam downstream to the Yuba River for non-listed and non-candidate species. For listed and candidate species, 'action' area as defined by the ESA 1973, as amended and it's associated implementing regulations. The specific scope will be defined for each element in the Study Plan.

Existing Information:

1. Abundance and emigration timing of juvenile salmon and steelhead since 1996. Data comes from DWR-ESO operation of rotary screw traps, fyke traps, and seining. Traps typically operated from December through June.
2. Annual population estimates for fall and spring run salmon returning to spawn. Surveys conducted by DFG (using various methods) every fall since 1954.
3. Distribution and habitat use of juvenile salmon and steelhead. DWR-ESO study began in spring of 1999, utilizes snorkeling observations. Surveys are conducted from March - August on the Feather River between the Fish Barrier Dam and Gridley Bridge.
4. Survival and contribution rate of "wild" and hatchery produced salmon.
    a. DWR-ESO and DFG have been implanting coded wire tags in juvenile hatchery salmon since 1975. DWR-ESO began tagging "wild" juvenile salmon in 1998.
    b. Tags are recovered through ocean and inland harvest recovery programs coordinated by DFG.
    c. New analysis of tag recoveries underway through contract with SFSU Romberg Tiburon Center and USFWS.
5. Habitat surveys, habitat maps and gravel surveys.
    a. Depth, current velocity, substrate, in-stream cover, over-head cover are recorded as part of DWR-ESO steelhead and salmon habitat use studies in 1999 and 2000.
    b. Riffles, pools, glides and backwater habitats have been delineated on aerial photographs from the Fish Barrier Dam to the Gridley Bridge. This mapping was conducted by DWR-ESO as part of lower river fish studies in 1999, and with 1992 IFIM studies.

c. DWR Northern District published Feather River gravel condition reports in 1982 and 1996.

6. Historic stream flows in the low flow channel and below Thermalito Afterbay outlet.
7. Temperature data from the low flow channel and below Thermalito Afterbay outlet
    a. Hourly temperatures recorded at 20 sites between the Thermalito Diversion Dam and Live Oak by DWR-ESO. Began in 1997 but records are incomplete until 1999.
    b. USGS recorded temperatures at gage downstream from Oroville Dam, 1958 to 1992, continuous temperatures since 1995 by DWR.
    c. OFD has recorded mean daily water temperatures at the Feather River Hatchery since initiation of hatchery operations and Robinson Riffle since July 31, 2000.
    d. USGS has published records of maximum and minimum daily water temperatures at the Thermalito Afterbay Outlet from October 1968 through September of 1992. Since 1992, only mean daily water temperature data is available from OFD.
    e. River temperature model developed by UC Davis under contract with DWR-ESO in 2000
8. DWR-ESO Instream Flow study from 1992. Thirty-two transects selected between the Fish Barrier Dam and Honcut Creek. Salmon, steelhead and American shad were the target species.
9. Laboratory study on steelhead growth and thermal biology. Study conducted by UC Davis in 1999 under contract with DWR-ESO.
10. Macro-invertebrate food base available for rearing salmon and steelhead. Study began in Fall 2000 and will continue for two years. Funded by DWR-ESO through contract with Chico State University.
11. Stranding and redd dewatering study by DWR-ESO began in Fall 2000. Study will identify potential stranding areas between the Fish Barrier Dam and Honcut Creek, and attempt to quantify salmonid losses.
12. 2000 Spring-run and steelhead Biological Assessment

Information Needed:

Summary: Items 6, 10, 11, 12, 13 and 14 from Issue F1, plus Item 6 below.

1. Accurate data on arrival timing, spawning season, and population size of adult spring-run salmon. This information could be gathered by operating an upstream migrant counting facility, using a weir and/or hydro-acoustics. Supplemental information could also be gathered by extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River.
2. Data on arrival timing and population size of “wild” adult steelhead. This information could be gathered by operating an upstream migrant counting facility, using a weir and/or hydro-acoustics. Supplemental information could also be gathered by extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River.
3. Residence time, survival and growth of juvenile steelhead in the low flow channel. This information could be gathered by tagging steelhead and tracking their movement, survival and growth while living in the Feather River.

4. Preliminary instream flow study designed to evaluate channel changes since 1992 IFIM study and to specifically address flow effects on juvenile steelhead
5. Look at how changes in Yuba River flow (increasing transfers planned) affects flows within the Feather River.
6. Literature review on basic life history and potential project impacts on non-salmonid anadromous fishes including striped bass, American shad, green sturgeon, and white sturgeon.
7. Synthesis of existing and new information to evaluate the adequacy of flow constraints and effect of project operations.

Level of Analysis:

Studies will rely on literature review and field studies.

Issues Addressed by Issue Statement:

FE33 Are the present streamflows defined under the State Water Projects Feather River Flow Constraints being met and are they adequately protecting steelhead and fall, late-fall, and spring-run Chinook salmon in the low-flow section and in the river downstream of Thermalito Afterbay for migrating, holding, spawning, and rearing of steelhead and fall, late-fall, and spring-run Chinook salmon;

FE41 Early on and clearly identify flow rates and temperature requirements downstream of the dam;

FE46 Clearly identify species, landowners along river, flow rates and temperature requirements downstream of the dam;

FE53 Are the present project related flow ramping/fluctuation restraints adequately protecting rearing Salmonid species from being stranded in the low-flow section and in the river downstream of Thermalito Afterbay;

FE54 Are the present project related flow ramping/fluctuation restraints adequately protecting Salmonid redds and juveniles, conserving their habitat and forage, and spawning gravel from being scoured out from the low-flow section and from the river downstream of Thermalito Afterbay;

FE68 Assurances of how things will be done, guarantee credible data, and sustainability of solutions (adaptive management);

FE69 Page 8 Bullet 8 – split into two issues;

FE90 Adequacy of current project operating regimes and structures to optimize water quality conditions for anadromous salmonids and their habitats;

FE97 The habitat for fishes in the lower Feather River is affected by the flow releases from the project. Seasonal timing, volume, and rate of release all have an affect on fish habitat conditions. Potential changes in license conditions for flow releases could adversely affect habitat conditions for one or more fish species. Fishery investigations should examine the adequacy of flows for maintaining all life history needs for anadromous and resident species. There should be evaluation of potential for flow improvements in the low-flow section. Fishery investigations should be sufficient to determine how best to meet the combined needs of the various anadromous and resident fish species;

W10 Effects of existing and future water releases and operations on water temperatures in the Diversion Pool, Forebay, Afterbay, Oroville Wildlife Area, low-flow section of the river and downstream areas; at the hatchery; for

agriculture; and the quality and availability of habitat for salmonids and other aquatic resources;

W11 Existing and future project compliance with temperature requirements of the SWP Feather River Flow Constraints and effectiveness of constraints for a) protection of salmonids in the low-flow and high-flow sections of the Feather River; and b) hatchery operation;

WE20 Are the existing temperature requirements defined under the State Water Projects Feather River Flow Constraints adequate for the operation of the Feather River Hatchery;

G1 Effects of existing and future project operations on natural geomorphic processes. These include physical attributes and functions (e.g., channel morphology, channel stability, sediment transport and deposition, spawning gravel and large woody debris recruitment, habitat diversity) and subsequent effects on biological resources (e.g., aquatic macro-invertebrates, riparian vegetation) in the low-flow section and in the Feather River downstream of Thermalito Afterbay under wet and dry year criteria. Also, see W8,F3,F10, T5.

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F13. Project Effect on Listed Fish Species

Issue Statement: Project effects on fish species listed for protection under the California and/or federal Endangered Species Acts (ESA), species of special concern, candidate species, proposed, and likely listed threatened and/or endangered fish species, and the habitat needed to support them.

Resource Goals:

- Minimize and mitigate adverse project impacts on habitat, genetic integrity and population size of listed species.
- Increase natural production of steelhead and spring-run chinook.
- Restore populations of listed fish species.

Scope: 'Action' area as defined by the ESA 1973, as amended and it's associated implementing regulations. The specific scope will be defined for each element in the Study Plan.

Existing Information:

1. Abundance and emigration timing of juvenile salmon and steelhead since 1996. Data comes from DWR-ESO operation of rotary screw traps, fyke traps, and seining. Traps typically operated from December through June.
2. Annual population estimates for fall and spring run salmon returning to spawn. Surveys conducted by DFG (using various methods) every fall since 1954.
3. Distribution and habitat use of juvenile salmon and steelhead. DWR-ESO study began in spring of 1999, utilizes snorkeling observations. Surveys are conducted from March - August on the Feather River between the Fish Barrier Dam and Gridley Bridge.
4. Habitat surveys, habitat maps and gravel surveys.
    a. Depth, current velocity, substrate, in-stream cover, over-head cover are recorded as part of DWR-ESO steelhead and salmon habitat use studies in 1999 and 2000.
    b. Riffles, pools, glides and backwater habitats have been delineated on aerial photographs from the Fish Barrier Dam to the Gridley Bridge. This mapping was conducted by DWR-ESO as part of lower river fish studies in 1999, and with 1992 IFIM studies.
    c. DWR Northern District published Feather River gravel condition reports in 1982 and 1996.
5. Historic stream flows in the low flow channel and below Thermalito Afterbay outlet.
6. Temperature data from the low flow channel and below Thermalito Afterbay outlet
    a. Hourly temperatures recorded at 20 sites between the Thermalito Diversion Dam and Live Oak by DWR-ESO. Began in 1997 but records are incomplete until 1999.
    b. USGS recorded temperatures at gage downstream from Oroville Dam, 1958 to 1992, continuous temperatures since 1995 by DWR

c. OFD has recorded mean daily water temperatures at the Feather River Hatchery since initiation of hatchery operations and Robinson Riffle since July 31, 2000.
d. USGS has published records of maximum and minimum daily water temperatures at the Thermalito Afterbay Outlet from October 1968 through September of 1992. Since 1992, only mean daily water temperature data is available from OFD.
e. River temperature model developed by UC Davis under contract with DWR-ESO in 2000

7. DWR-ESO Instream Flow study from 1992. Thirty-two transects selected between the Fish Barrier Dam and Honcut Creek. Salmon, steelhead and American shad were the target species.
8. Laboratory study on steelhead growth and thermal biology. Study conducted by UC Davis in 1999 under contract with DWR-ESO.
9. Macro-invertebrate food base available for rearing salmon and steelhead. Study began in Fall 2000 and will continue for two years. Funded by DWR-ESO through contract with Chico State University.
10. Stranding and redd dewatering study by DWR-ESO began in Fall 2000. Study will identify potential stranding areas between the Fish Barrier Dam and Honcut Creek, and attempt to quantify salmonid losses.
11. Genetic characterization of Central Valley Chinook salmon at UC Davis funded by DWR-ESO. Studies analyze Feather River hatchery spring run, summer run, and fall run and will determine their relationship to other Central Valley populations.
12. 2000 Spring-run and steelhead Biological Assessment
13. March 2001 Spring-run and steelhead Biological Opinion

Information Needed:

1. Accurate data on arrival timing, spawning season, and population size of adult spring-run salmon. This information would be gathered by operating an upstream migrant counting facility, using a weir and/or hydro-acoustics. Supplemental information would be gathered by extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River.
2. Data on arrival timing and population size of “wild” adult steelhead. This information would be gathered by operating an upstream migrant counting facility, using a weir and/or hydro-acoustics. Supplemental information would also be gathered by extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River.
3. Residence time, survival and growth of juvenile steelhead in the low flow channel. This information would be gathered by tagging steelhead and tracking their movement, survival and growth while living in the Feather River.
4. Preliminary instream flow study designed to evaluate channel changes since 1992 IFIM study and to specifically address flow effects on juvenile steelhead
5. Synthesis of existing and new information to evaluate project impacts on listed species.
6. Genetic analysis of Feather River steelhead, spring run and fall run salmon – compare hatchery to non-hatchery stock.
7. Impacts to endangered fish by handling (weirs)

Level of Analysis:

The study will rely on literature reviews and field studies to assess project effects on listed fish populations and habitat.

Issues Addressed by Issue Statement:

FE57 Provide habitat leading to viable populations of endangered species. Maintain habitat to support viable populations of all native and desired nonnative vertebrate species;

FE60 Species recovery in upper and lower river;

FE68 Assurances of how things will be done, guarantee credible data, and sustainability of solutions (adaptive management);

FE71 Species recovery in reservoir and river;

FE72 ESA compliance, want to hear about conflicts with folks and other species (bald eagles);

FE86 Adequacy of current ramping rate to protect anadromous salmonids and conserve their habitats and forage. This includes providing a range of schedule of flows necessary to optimize habitat, stable flows during spawning and incubation of in gravel forms, flows necessary to ensure redd replacement in viable areas, and flows necessary for channel forming processes, riparian habitat protection and maintenance of forage communities. This also includes impacts of flood control or other project structures or operations that act to displace individuals or their forage or destabilizes, scours, or degrades habitat;

FE91 Current condition of habitat potentially impacted by project and alternatives to conserve or enhance anadromous salmonids;

FE95 The lower Feather River provides habitat to support a variety of anadromous fish species including Chinook salmon, steelhead, striped bass, American shad and sturgeon. Potential changes in license conditions could adversely impact habitat supporting these species. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements for the various life history needs of anadromous species including flow, water temperature, instream and riparian cover, substrate and spatial area;

FE97 The habitat for fishes in the lower Feather River is affected by the flow releases from the project. Seasonal timing, volume, and rate of release all have an affect on fish habitat conditions. Potential changes in license conditions for flow releases could adversely affect habitat conditions for one or more fish species. Fishery investigations should examine the adequacy of flows for maintaining all life history needs for anadromous and resident species. There should be evaluation of potential for flow improvements in the low-flow section. Fishery investigations should be sufficient to determine how best to meet the combined needs of the various anadromous and resident fish species;

G1 Effects of existing and future project operations on natural geomorphic processes. These include physical attributes and functions (e.g., channel morphology, channel stability, sediment transport and deposition, spawning gravel and large woody debris recruitment, habitat diversity) and subsequent effects on biological resources (e.g., aquatic macro-invertebrates, riparian vegetation) in the low-flow section and in the Feather River downstream of Thermalito Afterbay under wet and dry year criteria. Also, see W8,F3,F10, T5;

T2 Project effects on federal and state listed, species of concern, candidate, proposed, and likely listed threatened, endangered and sensitive plant and animal species and the habitat needed to support them. Concerns include, but are not limited to, amphibians, bald eagle foraging habitat, winter roosts, and nesting territories;

T3 Effects of existing and future project operations on floodplains and water fluctuation zones, including soil stability, wildlife habitat and natural flood control functions, revegetation and restoration opportunities (e.g., red willow planting).

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F14. Feather River Salmon Production

Issue Statement: Effects of existing and future project facilities and operations on the levels of recruitment of Feather River salmonids to the ocean population (e.g., sustained production of 20 percent of the commercial catch).

Resource Goals:

- Minimize and mitigate adverse project impacts on habitat, genetic integrity and population size of anadromous fishes.
- Provide populations of Chinook salmon sufficient to support desired recreational and commercial fisheries.

Scope: Feather River Fish Hatchery and the Feather River from the Fish Barrier Dam downstream to Honcut Creek. To Pacific Ocean to get data.

Existing Information:

1. Abundance and emigration timing of juvenile salmon and steelhead since 1996. Data comes from DWR-ESO operation of rotary screw traps, fyke traps, and seining. Traps typically operated from December through June.
2. Annual population estimates for fall and spring run salmon returning to spawn. Surveys conducted by DFG (using various methods) every fall since 1954.
3. Distribution and habitat use of juvenile salmon and steelhead. DWR-ESO study began in spring of 1999, utilizes snorkeling observations. Surveys are conducted from March - August on the Feather River between the Fish Barrier Dam and Gridley Bridge.
4. Survival and contribution rate of “wild” and hatchery produced salmon.
    a. DWR-ESO and DFG have been implanting coded wire tags in juvenile hatchery salmon since 1975. DWR-ESO began tagging “wild” juvenile salmon in 1998.
    b. Tags are recovered through ocean and inland harvest recovery programs coordinated by DFG.
    c. New analysis of tag recoveries underway through contract with SFSU Romberg Tiburon Center and USFWS.
5. Habitat surveys, habitat maps and gravel surveys.
    a. Depth, current velocity, substrate, in-stream cover, over-head cover are recorded as part of DWR-ESO steelhead and salmon habitat use studies in 1999 and 2000.
    b. Riffles, pools, glides and backwater habitats have been delineated on aerial photographs from the Fish Barrier Dam to the Gridley Bridge. This mapping was conducted by DWR-ESO as part of lower river fish studies in 1999, and with 1992 IFIM studies.

    c. DWR Northern District published Feather River gravel condition reports in 1982 and 1996.
6. Historic stream flows in the low flow channel and below Thermalito Afterbay outlet.
7. Temperature data from the low flow channel and below Thermalito Afterbay outlet
    a. Hourly temperatures recorded at 20 sites between the Thermalito Diversion Dam and Live Oak by DWR-ESO. Began in 1997 but records are incomplete until 1999.
    b. USGS recorded temperatures at gage downstream from Oroville Dam, 1958 to 1992, continuous temperatures since 1995 by DWR.
    c. OFD has recorded mean daily water temperatures at the Feather River Hatchery since initiation of hatchery operations and Robinson Riffle since July 31, 2000.
    d. USGS has published records of maximum and minimum daily water temperatures at the Thermalito Afterbay Outlet from October 1968 through September of 1992. Since 1992, only mean daily water temperature data is available from OFD.
    e. River temperature model developed by UC Davis under contract with DWR-ESO in 2000
8. DWR-ESO Instream Flow study from 1992. Thirty-two transects selected between the Fish Barrier Dam and Honcut Creek. Salmon, steelhead and American shad were the target species.
9. Macro-invertebrate food base available for rearing salmon and steelhead. Study began in Fall 2000 and will continue for two years. Funded by DWR-ESO through contract with Chico State University.
10. Stranding and redd dewatering study by DWR-ESO began in Fall 2000. Study will identify potential stranding areas between the Fish Barrier Dam and Honcut Creek, and attempt to quantify salmonid losses.
11. 2000 Spring-run and steelhead Biological Assessment.
12. March 2001 Spring-run and steelhead Biological Opinion.
13. June 2001 Joint Hatchery Review Committee Final Report on Anadromous Salmonid Fish Hatcheries in California.
14. Survival and contribution rate of “wild” and hatchery produced salmon.
    a. DWR-ESO and DFG have been implanting coded wire tags in juvenile hatchery salmon since 1975. DWR-ESO began tagging “wild” juvenile salmon in 1998.
    b. Tags are recovered through ocean and inland harvest recovery programs coordinated by DFG.
    c. New analysis of tag recoveries underway through contract with SFSU Romberg Tiburon Center and USFWS.

Information Needed:

1. Accurate data on arrival timing, spawning season, and population size of adult spring-run salmon. This information would be gathered by operating an upstream migrant counting facility, using a weir and/or hydroacoustics. Supplemental information could also be gathered by extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River.

2. Data on arrival timing and population size of “wild” adult steelhead. This information would be gathered by operating an upstream migrant counting facility, using a weir and/or hydro-acoustics. Supplemental information could also be gathered by extending the operational period of the Feather River Hatchery fish ladder and by conducting intensive year-round angler surveys in the Feather River.
3. Residence time, survival and growth of juvenile steelhead in the low flow channel. This information could be gathered by tagging steelhead and tracking their movement, survival and growth while living in the Feather River.
4. Preliminary instream flow study designed to evaluate channel changes since 1992 IFIM study and to specifically address flow effects on juvenile steelhead
5. Synthesis of existing and new information to evaluate project impacts on Feather River salmon production.
6. Carrying capacity of Pacific Ocean for salmon.
7. Percentage of juvenile salmon migrating through the Sacramento River System that are Feather River salmon. (Pacific Council on Fisheries may have information addressing this)

Level of Analysis:

Studies will rely on literature review and field studies.

Issues Addressed by Issue Statement:

FE61 Maintain Feather River contribution of 20% of the commercial ocean salmon catch;
FE91 Current condition of habitat potentially impacted by project and alternatives to conserve or enhance anadromous salmonids.

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F16. Predators

Issue Statement: Effects of existing and future project facilities and operations on the abundance of predators, their seasonal and geographic distribution, the impact of predation mortality on population dynamics of salmonids and other species, and alternatives for predator control and management (including prevention of introductions).

Resource Goals:

- Minimize adverse project impacts that increase predation pressure on salmonids and other species beyond natural or expected rates.

Scope: From the Fish Barrier Dam downstream to confluence with the Sacramento River.

Existing Information:

1. Abundance and emigration timing of juvenile salmon, steelhead and other species since 1996. Data comes from DWR-ESO operation of rotary screw traps, fyke traps, and seining. Traps typically operated from December through June.
2. Distribution and habitat use of salmonids and other species. DWR-ESO study began in spring of 1999, utilizes snorkeling observations. Surveys are conducted from March - August on the Feather River between the Fish Barrier Dam and Gridley Bridge.
3. Tethering study conducted by DWR in summer of 1999. This one-time experiment measured frequency of predator attacks on live, tethered baitfishes at various locations and in different habitat in the lower Feather River.
4. Literature from scientific journals and other relicensing efforts.

Information Needed:

1. Literature review of likely predators and predation effects on salmonids in the lower Feather River. Preliminary assessment of project facilities and how they may enhance predation on salmonids beyond natural, background levels.
2. Predator surveys around artificial structures in the aquatic environment.
3. Literature review on hatchery production on wild salmonids
4. Effect of flow on predation rates, timing of flow releases
5. Population base of predators beyond the project boundary

Level of Analysis:

Preliminary investigation will rely on literature review and field studies.

Issues Addressed by Issue Statement:

FE22 Prevent Northern Pike from entering Lake Oroville by eliminating them from the licensee's upstream impoundments. If Northern Pike enter Lake Oroville and

Feather River watershed, aggressively address the problem and successfully eliminate the fish;

FE75 Project structures or operations that either have in the past, or continue to introduce predators, create suitable habitat for predators, harbor predators, or are conducive to the predation of salmonids;

FE76 Prevent the introduction of new piscivorous (fish-eating) predators (e.g., northern pike, striped bass, white bass, etc.) introductions to project waters;

FE77 Predation of fish species naturally occurs under all conditions. However, project conditions could exacerbate the occurrence of predation on certain species. Changes in license conditions could lead to unnecessary increase in predation on desirable gamefish or threatened and endangered species, or other species of concern. Occurrence (habitat, distribution and numbers of predator fish should be identified in all riverine waterways affected by project releases. Predation investigations should be comprehensive and predator management be available as a fishery management tool;

FE94 Evaluate the potential impacts of striped bass predation mortality on juvenile Chinook salmon and steelhead within the lower Feather River and the effects of project operations on predator–prey interactions, and identify and evaluate alternative methods for controlling and reducing predation mortality by species such as striped bass on juvenile rearing and emigrating salmonids.

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T1. Effects of Project Features and Operation on Wildlife and Wildlife Habitat

Issue Statement: Effects of project features, existing and future operations (including power generation, water storage and releases, ramping rates, pump-back, water levels and water level fluctuations), and maintenance on wildlife and wildlife habitat. Specific concerns include deer winter range, band-tailed pigeon winter habitat, designated emphasis and harvest species, wintering, brooding, and nesting waterfowl, and other wildlife use of project and project-affected waters.

Resource Goals:

- Minimize and mitigate project-related impacts on wildlife and wildlife habitat
- Enhance wildlife and wildlife habitat within the FERC project boundary

Scope: Within the FERC project boundary, downstream Feather River floodplain to the confluence with the Yuba River, and other adjacent areas as appropriate.

Existing Information:

1. List and location map of existing and currently proposed project facilities and associated activities
2. Scientific literature
3. DWR hydrology records including project inflow and outflow, water levels, and ramping rates.
4. DFG Deer Herd Plans
5. California Wildlife Habitat Relationships database
6. Agency management plans (USFS, DFG Wildlife Areas, BLM)
7. California Waterfowl Association – maintenance operation and brood ponds for waterfowl

Information Needed:

1. Identify habitats and species of interest (including critical life stages)
2. Identification of project features (i.e. ramping rates) that could affect these species and habitats
3. Wildlife habitat/plant community map produced in studies of Issue T4 (biodiversity).
4. Identification of potential new facilities or potential changes in operation
5. Location map of waterfowl use areas (nesting and wintering)
6. Analysis of potential project effects on habitats and species of interest (consult with other Work Groups on issues, such as Cultural Resources WG)

Level Of Analyses: Literature review, field survey followed by desktop impact analyses to determine potential conflict areas or activities.

Issues Addressed by Issue Statement:

TE2 Maintain winter habitat for bandtailed pigeons

TE3 Maintain or enhance deer winter range
TE17 Maintain habitat to support viable populations of all native and desired nonnative vertebrate species
TE18 Improve and protect habitat for designated emphasis and harvest species
TE19 Provide diversity of plant and animal communities and tree species by assuring the continuous and viable presence of all seral stages of all native plant communities on the forest
TE20 Provide a diversity of vegetation types and habitat to support viable populations of all fish, wildlife, and plant species
TE29 Interaction of lake with wildlife species (birds, amphibians, etc.) – how is lake used
TE39 Manage flows and/or reservoir storage to maintain or enhance riparian plant communities and habitat for all life stages of fish. Cooperate with local, State, and other Federal water management agencies. Protect riparian areas while providing developed facilities.
TE41 North forebay – preservation of existing wildlife
TE44a Preserve wildlife habitat in the diversion pool area
TE46 Improve terrestrial habitat with introduction of salmon (bears)
TE47 Continue inventory of plant and animal species in the project area
TE48 Protect riparian habitat in project area
TE50 Effects of fluctuating water levels in afterbay on wildlife
TE51 Restoration of areas used as stockpile sites during dam construction
TE57 Effects of reservoir surface elevation fluctuations on wildlife habitat
TE59 Operate water levels in Thermalito Afterby to prevent adverse impacts to Pacific Flyway waterfowl, especially during nesting in spring and early summer; continue to coordinate with DFG
TE60 Evaluate effects of proposed increases in recreational activity in Thermalito Afterbay on waterfowl and other wildlife
TE62 Protection and sustained conservation of terrestrial wildlife and flora in the project-affected area; comprehensive and well-crafted planning
F1 Effects of existing and future project operations (including power generation, water storage, ramping rates, and releases, pump-back, water levels, and water level fluctuations) during all water year types on the behavior (e.g., migration timing, microhabitat selection, vulnerability to predators), reproduction, survival and habitat of warm- and cold-water fish and other aquatic resources (e.g., macroinvertebrates), which include in project waters and tributaries within the project boundaries (Lake Oroville, Diversion Pool, Fish Barrier Pool, Forebay, Afterbay, Oroville Wildlife Area), and in project affected waters
FE28 North forebay –preservation of existing wildlife
W3 Effects of existing and future project operations on the physical, chemical and biological components of water quality of the Feather River, affected tributaries and downstream waters. The project has the potential for direct and indirect effects on aquatic ecosystem health, on recreational opportunity, and on domestic and agricultural water supply.
W7 Effect of existing and future project-related land management and watershed management activities (including waste disposal and pesticide use) on water quality, slope stability, erosion, sedimentation, channel stability, riparian habitat, fish habitat, and other beneficial uses.
W8 Effect of existing and future project facilities and operations on natural hydrology (i.e., impaired and unimpaired hydrology).

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T9. Recreation and Wildlife

Issue Statement: Effects of existing and future project-related recreation facilities, activities (including authorized and unauthorized access and use) and management on nesting and wintering Pacific Flyway waterfowl, other wildlife, and plant communities.

Resource Goals:

- Minimize and mitigate project-related recreation impacts on wildlife and plant communities
- Enhance nesting and wintering Pacific Flyway waterfowl and plant communities

Scope: Within the FERC project boundary

Existing Information:

1) List and location map of existing recreation facilities
2) Scientific literature on wildlife/recreation conflicts
3) Existing recreation plans
4) Current activities implemented to reduce wildlife recreation conflicts
5) Recreation use data for each facility (type, timing and amount)

Information Needed:

1) Impacts of recreation facilities and their associated use on nesting and wintering Pacific Flyway waterfowl and plant communities
2) Identification of operations and maintenance activities associated with each recreation facility
3) Wildlife habitat/plant community map produced in studies of Issue T4 (biodiversity).
4) Identification of potential new recreation facilities
5) Location map of waterfowl use areas (nesting and wintering)
6) Analysis of effects of existing and new recreation facilities

Level Of Analyses: Literature review and seasonal field survey followed by desktop impact analyses to determine potential conflict areas or activities.

Issues Addressed by Issue Statement:

T59 Operate water levels in Thermalito Afterbay to prevent adverse impacts to Pacific Flyway waterfowl, especially during nesting in spring and early summer; continue to coordinate with DFG

T60 Evaluate effects of proposed increases in recreational activity in Thermalito Afterbay on waterfowl and other wildlife

T62 Protection and sustained conservation of terrestrial wildlife and flora in the project-affected area; comprehensive and well-crafted planning

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W4. Effects of Project Operations and Facilities on Water Quality

Issue Statement: Effects of existing and future project operations and facilities and its associated recreational facilities, activities, and uses on water quality. Proximity of project features and recreational facilities to shoreline and banks of water bodies offers potential for introduction of nutrients and bacterial contaminants to these waters.

Resource Goals:

- Minimize and mitigate adverse effects of project operations, facilities, and recreation features on water quality.
- Enhance water quality to the extent possible with project operations to protect beneficial uses.

Scope: Within the FERC project boundary and downstream as appropriate.

Existing Information:

1. Goals and criteria from W3.

2. Initial Information Package - identifies and analyzes existing water quality information, project facilities and operation, and recreation facilities, summarized in W3.

Information Needed:

1. Supplemental water quality data from W3, W5, and W7.

2. Reservoir water level fluctuation data from G4

3. Identification of future project operation and facilities

4. Evaluate effects of any new project operations or facilities, analyze existing and supplemental water quality data, and determine any project operation or facility impacts in relation to water quality goals and criteria.

5. History of the Kelley Ridge subdivision sewer line – identify potential link to the project

6. Literature search related to tertiary treated water from Oroville

Level of Analysis:

Review existing operation, facilities, and water quality information, collect additional information where needed, and evaluate information to determine effects of existing and any future project operations and facilities on water quality

Issues Addressed by Issue Statement:

WE5 Proximity of project features and recreational facilities to shoreline and banks of water bodies offers potential for introduction of nutrients and bacterial contaminants to these waters. What are the water quality trends (including, but not limited to, nitrogen, phosphorous and coliform bacteria levels) associated with project related activities;

WE35 Water contamination at North Forebay related to swimming opportunities;

WE43 Sewage spills into Lake Oroville;

WE44 Fuel spills as a result of fluctuating lake levels;

WE45 Effect on water quality from boat maintenance and cleaning products -- "biodegradable";

FE8 Lake Oroville releases made for power generation may cause dramatic fluctuations in lake level. What are the potential impacts of fluctuation zone and surface elevation change on recreation opportunities and on fish and wildlife habitat?

FE16 Establish and locate area for bass tournaments on the lake and include stands, parking, water, electricity, vendors, boats, etc.;

FE20 Develop bank fishing sites, cutaways used as fish habitat;

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W7. Effects of Project Related Land Management Activities

Issue Statement: Effect of existing and future project-related land management and watershed management activities (including waste disposal and pesticide use) on water quality, slope stability, erosion, sedimentation, channel stability, riparian habitat, fish habitat, and other beneficial uses.

Resource Goals:

- Minimize and mitigate adverse project related land management activities on water quality, slope stability, erosion, sedimentation, channel stability, riparian habitat, fish habitat, and other beneficial uses.
- Protect riparian areas and water quality by limiting disturbance in streamside management zones according to ground slope and stability, stream class, channel stability, fishery, and other beneficial uses
- Avoid water quality degradation by using Best Management Practices during land management activities
- Reduce sedimentation and channel erosion by rehabilitating deteriorating watersheds

Scope: Within the FERC project boundary and outside the project boundary as appropriate.

Existing Information:

1. Goals and criteria from W3.

2. Initial Information Package - identifies and analyzes existing water quality information, summarized in W3.

3. U.S. Soil Conservation Service report “The East Branch North Fork Feather River Erosion Inventory Report” of 1989 estimated that 90 percent of erosion in study area was accelerated by human activities.

4. PG&E data on sediment deposition in reservoirs on North Fork and remediation plans

5. Lake Oroville Siltation Study in 1994 estimated sedimentation into Lake Oroville at 18,000 acre-feet of deposition

6. Plans, policies, and ordinances:
   - Butte County General Plan and Zoning Ordinance
   - DWR Recreation Plan for Lake Oroville State Recreation Area
   - Plumas National Forest Land and Resource Management Plan
   - Redding Resource Management Plan of the Bureau of Land Management
   - DPR Resource Management Plan and General Development Plan for the Lake Oroville State Recreation Area
   - DFG Oroville Wildlife Management Area Management Plan

- City of Oroville General Plan

Information Needed:

1. Identify land and watershed management practices that could potentially affect water quality

2. Summary and identification of overlap and conflicts on project lands of existing land use plans, policies, and ordinances within and adjacent to the FERC project boundary

3. Recreation Resources Management Plan and Shoreline Management Plan developed by the Recreation Workgroup

4. Inventory of existing land uses in project area and areas affecting project

5. Inventory of project area and adjacent areas affecting project for natural and sensitive resources, including wetlands, floodplains, ground slopes, stability problem areas (including erosion inventory/sensitivity map, landslides and identification of landslide risk areas), stream classes, channel stability, and riparian areas.

6. Evaluate land and watershed management activities and uses to determine effects to sensitive areas (livestock)

Level of Analysis:

Review available information and new recreation and shoreline plans, collect additional information where needed, and conduct desktop analyses of potential effects on water quality, slope stability, erosion, sedimentation, channel stability, riparian habitat, fish habitat, and other beneficial uses within the FERC project boundary.

Issues Addressed by Issue Statement:

WE8 Provide protection of riparian areas and water quality by limiting disturbance in streamside management zones according to ground slope and stability, stream class, channel stability, fishery, and other beneficial uses, and favor riparian-dependent resources in cases of competing resource demands;

WE11 Avoid water quality degradation by using Best Management Practices during land management activities, and reduce sedimentation and channel erosion by rehabilitating deteriorating watersheds;

WE13 Reduce sediment yields from watersheds in deteriorating conditions and those tributary to eroding channels or hazardous flood prone areas;

WE41 What coordination for Page 2 #5? -- Could be items along roads that might sweep into the river during floods;

WE46 Spawning habitat in tributaries as they relate to operations;

T1 Effects of project features, existing and future operations (including power generation, water storage and releases, ramping rates, pump-back, water levels and water level fluctuations) and maintenance on wildlife and wildlife habitat. Specific concerns include deer winter range, band-tailed pigeon winter habitat, designated emphasis and harvest species, wintering, brooding, and nesting waterfowl, and other wildlife use of project and project-affected waters;

T3 Effects of existing and future project operations on floodplains and project water fluctuation zones, including soil stability, wildlife habitat and natural flood control functions, revegetation of native plant communities, and restoration opportunities (e.g., red willow planting);

T5 Project effects on riparian resources and protection and management of riparian habitat and wetlands (including vernal pools and brood ponds);

T10 Effects of existing and future project features, operations and maintenance on upland habitat types, including revegetation and restoration efforts;

GE1 As needed, remove excavated material from the floodplain;

GE15 Avoid water quality degradation by using Best Management Practices during land management activities, and reduce sedimentation and channel erosion by rehabilitating deteriorating watersheds;

GE17 Reduce sediment yields from watersheds in deteriorating conditions and those tributary to eroding channels or hazardous flood prone areas;

GE18 Re-vegetate disturbed areas within the floodplains to stabilize soil, benefit fish and wildlife, and restore the natural flood control qualities;

FE11 Inventory streams, streamside areas, and other wetlands in deteriorating condition and restore on a priority basis within project area and/or project-affected areas;

FE39 Insure that stream alterations restore the original flow capacity while preserving the existing channel alignment.

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W8. Effects of Project on Natural Hydrology

Issue Statement: Effect of existing and future project facilities and operations on natural hydrology (i.e., impaired and unimpaired hydrology).

Resource Goals:

- Minimize and mitigate adverse project effects on natural hydrology
- Restore more natural hydrograph to the extent possible consistent with project purposes

Scope: Within the FERC project boundary and downstream to the Sacramento River.

Existing Information:

1. Initial Information Package - identifies project facilities and operations

2. Discharge records for the Feather River and tributaries

Information Needed:

1. Supplemental discharge records from the Feather River and tributaries

2. Identification of future project operation and facilities

3. Model of project operations for impaired and unimpaired hydrology (information from E4)

4. Operations of upstream reservoirs.

5. Evaluate effects of project operations on natural hydrology using model to compare impaired and unimpaired (pre-project) hydrology

Level of Analysis:

Review existing operation, facilities, and discharge information, collect additional information where needed, and evaluate information using model to determine effects of existing and any future project operations and facilities on natural hydrology.

Issues Addressed by Issue Statement:

WE49 Project effects, by water type year and season, on natural hydrology, and restoration of a more natural hydrograph;
WE50 Conversion from lotic to lentic environment and accompanying changes in water quality;
T1 Effects of project features, existing and future operations (including power generation, water storage and releases, ramping rates, pump-back, water levels and water level

fluctuations) and maintenance on wildlife and wildlife habitat. Specific concerns include deer winter range, band-tailed pigeon winter habitat, designated emphasis and harvest species, wintering, brooding, and nesting waterfowl, and other wildlife use of project and project-affected waters;

FE97 The habitat for fishes in the lower Feather River is affected by the flow releases from the project. Seasonal timing, volume, and rate of release all have an affect on fish habitat conditions. Potential changes in license conditions for flow releases could adversely affect habitat conditions for one or more fish species. Fishery investigations should examine the adequacy of flows for maintaining all life history needs for anadromous and resident species. There should be evaluation of potential for flow improvements in the low-flow section. Fishery investigations should be sufficient to determine how best to meet the combined needs of the various anadromous and resident fish species;

GE6 Cumulative effects of project facilities and operations on sediment movement and deposition (e.g., recruitment of ocean beach sands) and other geomorphic processes (e.g., maintenance of a satisfactory abiotic habitat template).

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W11. Project Effects on Temperature Compliance

Issue Statement: Existing and future project compliance with temperature requirements of the SWP Feather River Flow Constraints and effectiveness of constraints for (a) protection of salmonids in the low-flow and high-flow sections of the Feather River; (b) hatchery operation; and (c) agricultural operations.

Resource Goals:
- Minimize and mitigate adverse project impacts on water temperatures
- Ensure that water temperatures downstream from Oroville Dam are suitable for all beneficial uses designated in the Basin Plan
- Minimize fish disease through thermal regulation downstream from Oroville Dam

Scope: Within and as appropriate, outside the FERC project boundary and downstream in the Feather River to the confluence with the Sacramento River

Existing Information:

1. Goals and criteria
   - Water Quality Control Plan (Basin Plan) for the Central Valley designates beneficial uses and specifies water quality objectives
   - Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish and Wildlife
   - Agreement on Diversion of Water from the Feather River
   - SWP Feather River Flow Constraints

2. Initial Information Package - identifies and analyzes existing temperature information and temperature requirements for the hatchery and agriculture, summarized in W3.

3. NMFS temperature goals for the Feather River downstream from Oroville Dam

4. On-going temperature data currently being collected by Dept. Fish and Game

Information Needed:

1. Anticipated future operation of the project

2. Temperature tolerance information for salmonids in the Feather River

3. Temperature model developed from W9 and W10

4. Temperature data from project waters for confirmation and calibration of model

5. Evaluate the temperature effects from significant discharge sources and other downstream points on the project's ability to meet water temperature requirements downstream.

6. Vegetation mapping of riparian corridor to assess potential water temperature moderating capacity (coordinate with T5)

7. Review of water quality criteria to maintain cold water fisheries (including Rock Creek)

8. Review local met data

9. Confirmation of temperature model, evaluation of model output, and comparison of model output to temperature requirements for salmonids, hatchery operations, and agriculture

Level of Analysis:

Review existing information, collect additional data where needed, and desktop analysis of model output to determine project compliance with temperature objectives

Issues Addressed by Issue Statement:

WE18 Are the existing temperature requirements defined under the State Water Projects Feather River Flow Constraints being met and are they adequately protecting steelhead and fall, late-fall, and spring-run chinook salmon in the low-flow section and in the river downstream of Thermalito Afterbay outlet;

WE20 Are the existing temperature requirements defined under the State Water Projects Feather River Flow Constraints adequate for the operation of the Feather River Hatchery;

WE21 Is the availability of a cold-water pool in Lake Oroville adequate under present and future operational demands to meet the cold-water requirements defined under the State Water Projects Feather River Flow Constraints for the Feather River Hatchery;

WE25 Does the present temperature model have the ability to forecast average daily water temperatures, under present and future operational demands, in the low-flow channel and in the river from the Thermalito Afterbay outlet down to Verona;

WE46 Spawning habitat in tributaries as they relate to operations;

WE54 Impact of project structures and operations on water quality conditions necessary to sustain anadromous salmonids and their habitat. Adequacy of current project operating regimes and structures to optimize water quality conditions for anadromous salmonids and their habitats;

F11 Compliance of project operations with SWP Feather River Flow Constraints and adequacy of constraints to protect anadromous fish and other aquatic species in the low-flow section and in the river downstream of the Afterbay;

FE33 Are the present streamflows defined under the State Water Projects Feather River Flow Constraints being met and are they adequately protecting steelhead and fall, late-fall, and spring-run Chinook salmon in the low-flow section and in the river downstream of Thermalito Afterbay for migrating, holding, spawning, and rearing of steelhead and fall, late-fall, and spring-run Chinook salmon;

FE41 Early on and clearly identify flow rates and temperature requirements downstream of the dam;

FE46 Clearly identify species, landowners along river, flow rates and temperature requirements downstream of the dam;

FE49 Incidence of fish disease in response to temperature changes below dam;

FE56 The Feather River's low-flow reach has historically provided spawning habitat for a cold-water fishery. How have reduced flows to this stream reach affected water temperature and gravel substrate necessary for successful salmonid reproduction?

FE89 Impact of project structures and operations on water quality conditions necessary to sustain anadromous salmonids and their habitats;

FE90 Adequacy of current project operating regimes and structures to optimize water quality conditions for anadromous salmonids and their habitats.

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W12. Access to Cold-water Pool

Issue Statement: Effects of existing and future project facilities and operations on access to the cold-water pool during below normal (BN) water years and multiple BN water years under existing and future operational demands, and effectiveness of the Temperature Control Device in providing access.

Resource Goals:
- Minimize and mitigate adverse project impacts on availability of cold water required for certain beneficial uses
- Ensure that water temperatures downstream from Oroville Dam are suitable for all beneficial uses during all hydrologic conditions.

Scope: Within the FERC project boundary

Existing Information:
1. Goals and criteria
   - Water Quality Control Plan (Basin Plan) for the Central Valley designates beneficial uses and specifies water quality objectives
   - Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish and Wildlife
   - SWP Feather River Flow Constraints

2. Initial Information Package - identifies and analyzes existing temperature information and project facilities, operation, and selective withdrawal facilities, summarized in W3.

3. Hydrologic data (i.e., rainfall, wet/dry year designations, reservoir stage, etc.)

4. Reservoir operation records.

5. Bathymetry

Information Needed:

1. NMFS temperature goals for Feather River downstream from Oroville Dam

2. Anticipated future operation of the project.

3. Temperature tolerance information for salmonids in the Feather River

4. Operations model for water levels from E4

5. Temperature model from W9 and W10

6. Temperature data for project waters for confirmation and calibration of model from W3.

7. Information related to project operations upstream of Oroville facility

8. Conduct model run to evaluate the ability of the project to access the cold water pool under various hydrologic conditions

Level of Analysis:

Review existing operation, facilities, and temperature information, collect additional information where needed, and evaluate information using model to determine effects of existing and any future project operations and facilities on access to the cold water pool.

Issues Addressed by Issue Statement:

WE19 Is the availability of a cold-water pool in Lake Oroville adequate under present and future operational demands to meet the existing downstream cold fresh-water habitat requirements of steelhead and fall, late-fall, and spring-run chinook salmon;

WE22 Does the existing Temperature Control Device (TCD) in Lake Oroville provide adequate access to the cold-water pool during below normal water or drier years;

WE23 Will the existing TCD in Lake Oroville provide adequate access to the cold-water pool under future operational demands particularly during a series of dry and critically dry years;

F1 Effects of existing and future project operations (including power generation, water storage, ramping rates, and releases, pump-back, water levels, and water level fluctuations) during all water year types on the behavior (e.g., migration timing, microhabitat selection, vulnerability to predators), reproduction, survival and habitat of warm- and cold-water fish and other aquatic resources (e.g., macroinvertebrates), which include in project waters and tributaries within the project boundaries (Lake Oroville, Diversion Pool, Fish Barrier Pool, Forebay, Afterbay, Oroville Wildlife Area), and in project affected waters;

FE3 Project effects on resident fish species (e.g., trout and other salmonids and warm-water fish) habitat quantity and quality (including instream flow, sediment, woody debris, water temperature, etc.,) and habitat for other aquatic species;

FE85 Impact of project facilities and operations on fish passage includes structures, flows, and/or water quality conditions that impede or block passage within and from current and/or historic habitat and operations that impact passage or have the potential to enhance passage. Passage includes movement of spawning or holding adults, emigrating smolts, or movement of juveniles to different habitat areas for purposes of feeding, avoiding predators, or sheltering;

FE89 Impact of project structures and operations on water quality conditions necessary to sustain anadromous salmonids and their habitats;

FE90 Adequacy of current project operating regimes and structures to optimize water quality conditions for anadromous salmonids and their habitats;

FE95 The lower Feather River provides habitat to support a variety of anadromous fish species including Chinook salmon, steelhead, striped bass, American shad and sturgeon. Potential changes in license conditions could adversely impact habitat supporting these species. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements for the various life history needs of anadromous species including flow, water temperature, instream and riparian cover, substrate and spatial area;

FE96 The lower Feather River provides habitat to support a variety of resident native and resident introduced species including coldwater species such as rainbow, brook, and brown trout, and warm water species such as bass, catfish, bluegill, green sunfish, carp and others. Potential changes in license conditions could adversely impact habitat supporting these species or upset habitat conditions such that less desirable species are favored. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements for the various life history needs of these resident native and non-native species including flow, water temperature, instream and riparian cover, substrate and spatial area.

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W14. Effects of Pump-back Operations

Issue Statement: Effects of existing and future pump-back operations on water quality and water temperatures (in Lake Oroville, Diversion Pool, Forebay, Afterbay, and Oroville Wildlife Area), habitat suitability, and out migration for salmonids.

Resource Goals:
- Minimize and mitigate adverse project effects on water quality and temperature due to pump-back operations
- Maintain suitable water quality and temperatures for fish and other aquatic resources in project waters.

Scope: Within the FERC project boundary.

Existing Information:

1. Goals and criteria from W3.

2. Initial Information Package - identifies and analyzes existing water quality and temperature information, and project facilities and operation, summarized in W3.

3. Fisheries data for the Feather River, including steelhead and salmon life histories, juvenile salmonid abundance and emigration patterns, and habitat preferences for salmonids.

4. Pump-back operational data, including schedules and depth of extraction and pump-back into Lake Oroville.

5. Temperature preferences for salmonids in the Feather River

6. NMFS temperature goals for the Feather River downstream from Oroville Dam

Information Needed:

1. Identification of water quality parameters potentially affected by pump-back operations

2. Limnological temperature profiles at shuttered intakes

3. Water quality and temperature monitoring of project waters (including Lake Oroville, Diversion Pool, Forebay, Afterbay, Afterbay Outlet, Afterbay agricultural diversions, Feather River, and Oroville Wildlife Area) during release of water for power production and pump-back operations.

4. Model to predict temperatures in project waters based on withdrawal temperatures from Oroville Dam, from W9 and W10.

5. Conduct model runs to determine effects of pump-back operations on water quality and temperatures in project waters in relation to habitat and salmonid needs.

Level of Analysis:

Review existing information, develop temperature model, collect additional information where needed for model calibration, and desktop analysis of model results to determine pump-back effects.

Issues Addressed by Issue Statement:

WE25 Does the present temperature model have the ability to forecast average daily water temperatures, under present and future operational demands, in the low-flow channel and in the river from the Thermalito Afterbay outlet down to Verona;

WE27 How does the pump-back operation during the summer months affect water temperatures required for holding and rearing of steelhead and spring-run chinook salmon in the low-flow section and in the river downstream of Thermalito Afterbay;

WE54 Impact of project structures and operations on water quality conditions necessary to sustain anadromous salmonids and their habitat. Adequacy of current project operating regimes and structures to optimize water quality conditions for anadromous salmonids and their habitats;

F1 Effects of existing and future project operations (including power generation, water storage, ramping rates, and releases, pump-back, water levels, and water level fluctuations) during all water year types on the behavior (e.g., migration timing, microhabitat selection, vulnerability to predators), reproduction, survival and habitat of warm- and cold-water fish and other aquatic resources (e.g., macroinvertebrates), which include in project waters and tributaries within the project boundaries (Lake Oroville, Diversion Pool, Fish Barrier Pool, Forebay, Afterbay, Oroville Wildlife Area), and in project affected waters;

FE3 Is the present minimum pool adequate for protecting the Lake Oroville cold-water sport fishery;

FE85 Impact of project facilities and operations on fish passage includes structures, flows, and/or water quality conditions that impede or block passage within and from current and/or historic habitat and operations that impact passage or have the potential to enhance passage. Passage includes movement of spawning or holding adults, emigrating smolts, or movement of juveniles to different habitat areas for purposes of feeding, avoiding predators, or sheltering;

FE89 Impact of project structures and operations on water quality conditions necessary to sustain anadromous salmonids and their habitats;

FE90 Adequacy of current project operating regimes and structures to optimize water quality conditions for anadromous salmonids and their habitats;

FE95 The lower Feather River provides habitat to support a variety of anadromous fish species including Chinook salmon, steelhead, striped bass, American shad and sturgeon. Potential changes in license conditions could adversely impact habitat supporting these species. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements for the various life history needs of anadromous species including flow, water temperature, instream and riparian cover, substrate and spatial area;

FE96 The lower Feather River provides habitat to support a variety of resident native and resident introduced species including coldwater species such as rainbow, brook, and

brown trout, and warm water species such as bass, catfish, bluegill, green sunfish, carp and others. Potential changes in license conditions could adversely impact habitat supporting these species or upset habitat conditions such that less desirable species are favored. Habitat investigations should evaluate the existing quality and quantity of habitat and determine alternative improvements for the various life history needs of these resident native and non-native species including flow, water temperature, instream and riparian cover, substrate and spatial area.

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W15. Toxic Spills

Issue Statement: Potential for non-project-related toxic spills (e.g., from railroad operations) and effects of toxic spills on project waters.

No FERC study plan is necessary for this issue. The FERC project has no effect on non-project related toxic spills from non-project related activities. DWR will work with other agencies that have direct responsibility for preparation of response plans for non-project related toxic spills. Project-related spills are addressed under existing operational plans.

Issues Addressed by Issue Statement:

WE51 Potential risk of non-project-related toxic spills and effects of toxic spills on project waters;

GE16 Coordinate with counties, Cal-Trans, and the Union Pacific Railroad to eliminate the side casting of waste material along travel ways, except at designated locations;

GE24 Direct, indirect, and cumulative impacts of project facilities and operations on sediment movement and deposition, river geometry, and channel characteristics. This includes impacts on stream competence, capacity, bank stability and extend, duration, and repetition of high flow events.

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W18. Project Effects on Natural Protective Processes

Issue Statement: Effect of existing and future project facilities and operations on natural protective processes (e.g., marshes).

Resource Goals:
- Minimize and mitigate adverse project effects on natural protective processes
- Enhance natural processes for maintaining water quality

Scope: Within the FERC project boundary.

Existing Information:
1. Literature about natural protective processes (wetlands, marshes, riparian areas, water filtration, riffles for oxygenation, sediment removal, biological filtering, etc.) effects on water quality.

2. Wetland, vegetation, and soil mapping, and GIS database from T5.

3. Riparian habitat quality from W7.

4. Riffle habitat quality and abundance from F10 and G1.

5. Aerial photography (Wayne coordinate with Ralph Torres and USFWS on planned flights)

Information Needed:
1. Identification of existing natural protective processes and their functioning in project waters

2. Review literature on natural protective processes, gather information from other studies, collect additional information as needed, and evaluated project facilities and operations on natural protective processes.

Level of Analysis:
Review existing information, collect additional information where needed, and conduct desktop analysis to determine project effects on natural protective processes.

Issues Addressed by Issue Statement:
WE9 Encourage natural protective processes